Assessment of the Risks of Human Success in the Long Term Based on Digital Processing Technologies of Biochemical Parameters Characterizing the Functional State of a Person

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Abstract—**Biochemical parameters for assessing the intersystem interactions of the body for different age groups are proposed to clarify the critical periods of the onset of the development of multifactorial pathologies. A qualitative analysis of multidimensional biomedical data was carried out using computer analysis programs. In the course of using modern digital technologies, quantitative criteria have been identified for diagnosing human functional states and predicting the risks of adverse changes in the body, which can lead to premature disability in the long term.**

Keywords—**Digital technologies, multidimensional biomedical data, multifactorial pathologies.**

I. INTRODUCTION

Currently, the issues of assessing the functional state of a person are very relevant, which directly determines the possibilities of performing various types of activities, and also expands the possibilities of predicting the level of human performance.

Analysis of the existing problem shows that despite a number of advances in the diagnosis of functional states in such industries as sports, astronautics, physiology, etc. effective methods have not yet been developed that allow predicting the level of human performance in the long term, which is very important for workers approaching the older age group.

Many agree that the study of functional states is impossible without an integral assessment of those functions of body systems that directly or indirectly determine the effective human activity in direct connection with the dynamics of working capacity [1] [2]. The development of a particular functional state is determined by the influence of many factors and mechanisms. These are the parameters of working and living conditions, social environment and individual characteristics of a person [2] [3]. In the literature, there is information about the development of a neural network model for the quantitative assessment of human functional states based on the indicator of predicting the biological age of a person. This model considers such indicators as passport age, body weight, height, systolic and diastolic blood pressure, mean pressure, stabilometric indicator – LFS. According to this model, the degree of deviation of the predicted biological age from the passport one depends on the functional state of the person [4].

The study and assessment of the intersystem interactions of the body at the level of biochemical processes for different age groups will make it possible to clarify the critical periods of the onset of the development of multifactorial pathologies, which will make it possible to study the regulatory systems of the body and develop quantitative criteria for diagnosing and predicting conditions. The solution to this problem can be carried out on the basis of the use of modern digital/computer technologies. A qualitative analysis of multivariate biomedical data obtained as a result of biochemical studies can only be carried out using computer programs for data analysis [5] [6]. These and other problems determine the relevance of these studies, the purpose of which was to identify biochemical criteria suitable for assessing the functional state of a person and predicting the risks of his success in the long term.

II. MATERIALS AND METHODS

The results of clinical examination of persons were analyzed. From archival materials of 2019-2020 years sample populations of patients in a clinical hospital were formed for the following age groups: 35-45, 46-55, 56-60, 61-65, 66-70, 71-80 years old, 81 years old and older. The following indicators were selected for the analysis: the level of cholesterol, glucose and bilirubin in the blood. The data were arrays for 7 age groups, for each group 2 arrays were selected: the first array (experimental group) – indicators of patients with pathology in the analysis results, the second (control group) – indicators of persons without pathologies. The control group included persons who did not have acute diseases at the time of investigation, as well as chronic diseases in the exacerbation stage. The experimental group brought together patients with various functional conditions and diseases. To analyze each indicator in each age group in

the control and experimental samples, the results obtained from 30 people (15 men and 15 women) were used. To analyze patient data, we used correlation, cluster and factor analyzes.

III. RESULTS

Zero correlations between the levels of cholesterol, glucose and bilirubin in the blood of patients mean the statistical independence of these indicators, i.e. the behavior of one component statistically tells us nothing about the behavior of the other. Therefore, it is quite sensible and often justified in practice is the assumption that biologically these new characters are quite autonomous, for example, reflecting different processes or phases of development.

One of the main physiological systems of a person, which determines his biological activity, is the cardiovascular system. Analysis of the dynamics of morbidity in the world indicates that the number of patients with pathologies of the heart and circulatory system is increasing sharply, especially with diseases characterized by high blood pressure. One of the biomarkers of the state of the cardiovascular system is the level of cholesterol in the blood, since it is believed that the main cause of cardiovascular disease is atherosclerotic vascular disease. This process usually takes several decades. In elderly people, fibrous atherosclerotic changes in the vascular wall are considered as a natural, although by no means an obligatory phenomenon. In cases where the clinical manifestations of this process occur before the age of 60, they speak of premature or early atherosclerosis.

In terms of cholesterol levels in the analysis of the mean values for all age groups, except for one, no significant changes were found. For the average values of indices of persons without pathology, an abnormally high peak was revealed in the group of 46-55 years. The analysis showed that at all ages, the level of cholesterol in the blood in men is higher than in women, and abnormal areas with high and low values in men and women are the same.

During the analysis of the results of clinical examination of able-bodied persons, it was revealed that, starting from the age of 35, in half of the examined the level of total cholesterol exceeds the acceptable level, which is a risk factor for the development of atherosclerosis. At the same time, statistical analysis showed that the highest percentage of mortality from cardiovascular diseases is in the group of people aged 46-55, which, according to literature data, indicates an early manifestation of atherosclerosis [7]. It is believed that the rate of atherosclerotic vascular lesions only increases with age. From our forecast based on statistical data, it follows: the number of patients with diseases of the circulatory system, including high blood pressure, will increase by ~ 30% in the next five years, which may lead to a loss of the share of the working-age population due to an increase in persons with disabilities and growth premature mortality from these diseases.

With increasing age, the average blood glucose levels in the analyses of individuals without pathology gradually increase. In the analyses of patients with pathology, an anomaly was found in the values of the indicator in the groups of 46-55 and 55-60 years (however, for more accurate conclusions, arrays with a larger sample of data are required); otherwise, the mean blood glucose level remained

practically unchanged. The analysis showed that at all ages, the blood glucose level in men is higher than in women, and abnormal areas with high and low values in men and women coincide.

During the analysis of the results of clinical examination of able-bodied persons, hyperglycemia was revealed, along with hypercholesterolemia in more than half of the examined, starting from the age of 46. In this case, hyperglycemia and arterial hypertension are factors that synergistically enhance atherosclerotic vascular lesions. These results indicate negative changes that can lead to a decrease in the body's functional capabilities and disability.

With increasing age, the average levels of bilirubin in the blood in the analyses of persons without pathology show a smooth increase. In analyses of patients with pathology, a tendency towards a slow decline was found (however, for statistically more accurate conclusions, arrays with a larger sample of data are required). In all age groups, the level of bilirubin in the blood in men is higher than in women, and abnormal areas with high and low values in men and women are the same.

Cluster analysis showed that the closest are clusters of biochemical indicators of groups of people 66-70 years old with pathology and 71-80 years old without pathology, 61-65 years old with pathology and 66-70 years old without pathology, 46-55 years old with pathology and 46-55 years without pathology, 56-60 years with pathology and 61-65 years without pathology.

With the help of factor analysis, it was found that all the factors considered have an effect on the biochemical parameters of blood: the presence/absence of pathology, gender and age of the study participants. For such indicators as the levels of cholesterol, glucose and bilirubin in the blood, the most significant factor is the presence/absence of pathology; the next most important factor is gender; the last factor in importance is the person's age.

The new reality is that the boundaries of the functional age are changing, which is due to a number of reasons: the acceleration of the pace of life (most important for hypertension), technological progress, the use of new synthetic materials in industry, construction, everyday life, the deterioration of the environmental conditions of human life, as well as a change in quality nutrition.

In this regard, a paradigm shift of successful professional old age is taking place. If we want a person to remain active, able to work at the age of 60+, then it is necessary to change the approach to achieve the goal: it is necessary to control the biochemical indicators of the functional state of the body and start working as early as possible on the prevention of the influence of biomedical factors that reduce the working capacity of employees.

The developed method for characterizing the functional state based on blood biochemical parameters can be used to predict the risk of adverse changes in the body, which can lead to premature disability.

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